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METHODS OF MEASUREMENTS FOR MULTI-CHANNEL TELEVISION TUNERS

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MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
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Indian Standard

METHODS OF MEASUREMENTS FOR MULTI-CHANNEL TELEVISION TUNERS

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Indian Standard

METHODS OF MEASUREMENTS FOR MULTI-CHANNEL TELEVISION TUNERS

0. FOREWORD

0.1 This Indian Standard was adopted by the Indian Standards Institution on 27 March 1987, after the draft finalized by the Radio Communications Sectional Committee had been approved by the Electronics and Telecommunication Division Council.

0.2 The object of this standard is to lay down the general conditions and uniform test methods for carrying out measarements on multichannel television tuners so as to make possible the comparison of the results of measurements. Limiting values of the various quantities for acceptable performance are not specified in this standard.

0.3 A recommended list of test equipment required with tuner manufacturer for testing of tuners is given in Appendix A.

0.4 The methods of measurements specified in this standard are harmonized with Department of Electronics, specifications for multichannel television tuners.

0.5 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test, shall be rounded off in accordance with IS : 2-1960*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

1. SCOPE

1.1 This standard lays down general conditions and methods of measurements for multichannel television tuners [both electronic and electromechanical (turret type)] designed for use either in 'very high frequency' (VHF) range or 'ultra high frequency' (UHF) range or both.

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*Rules for rounding off numerical values (*revised*).

2. TERMINOLOGY

2.0 For the purpose of this standard the terms and definitions covered in IS : 1885 (Part 24)-1967* and IS : 4545 (Part 1)-1983† in addition to the following shall apply.

2.1 Tuner — That part of the television receiver which performs the job of selecting the desired channel frequency and rejecting all others.

3. GENERAL CONDITIONS OF MEASUREMENTS

3.1 Ambient Conditions for Measurements

3.1.1 Unless specified otherwise, all measurements shall be carried out under the following ambient conditions:

Temperature	15°C-35°C
Relative humidity	45-75 percent
Air pressure	860-1 060 mbar

3.2 Referee Conditions

3.2.1 In case where the characteristics are sensitive to ambient conditions, the following referee conditions shall be maintained during the measurements:

Temperature	25 ± 1°C
Relative humidity	65 ± 2 percent
Air pressure	860 mbar to 1 060 mbar

3.3 In case the impedances of the tuner under test and the test equipment do not match, suitable matching networks shall be used. The necessary compensation for insertion loss shall be taken into account wherever necessary.

3.4 The radio frequency input signal, input arrangements and the recommended value for RF input signal levels shall be in accordance with **7**, **8** and **9** of IS : 4545 (Part 1)-1983†. Unless specified otherwise, the A.G.C. voltage shall be adjusted for a nominal gain of 20 dB.

4. TEST METHODS

4.1 Intermediate Frequency (Tuning) (Functional Check of Local Oscillator)

4.1.1 The test set up shall be as shown in Fig. 1. Energise the tuner with proper power supply. For a particular channel feed vision carrier frequency.

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*Electrotechnical vocabulary: Part 24 Broadcasting sound and television.

†Methods of measurement of receivers for television broadcast transmissions: Part 1 General considerations (*first revision*).

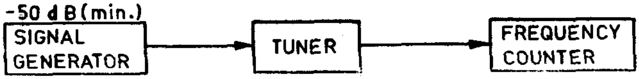


FIG. 1 TEST SET-UP FOR IF MEASUREMENT

4.1.2 Measure the output frequency using a frequency counter. If it is not 38.9 MHz, adjust the tuning control until the IF output is 38·9 MHz.

4.1.3 Repeat **4.1.1** and **4.1.2** for other channels.

4.2 Input Impedance

4.2.1 This measurement shall be carried out in a shielded enclosure.

4.2.2 The test set up shall be as shown in Fig. 2. Energise the tuner with proper power supply. AGC voltage is set for maximum gain. For a particular channel, tune the signal generator to the mid-channel frequency.

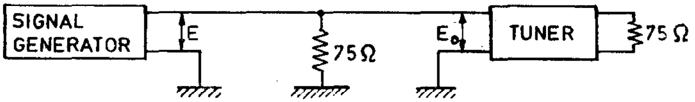


FIG. 2 TEST SET-UP FOR INPUT IMPEDANCE MEASUREMENT

4.2.3 Measure voltages E and E_0.

4.2.4 The input impedance R_{IN} is calculated using the formulae:

$$R_{IN} = \frac{75\,E_0}{E - E_0}$$

NOTE — Calculations shown are for 75 ohms case.

4.2.5 Repeat the measurements for other channels.

4.3 Output Impedance

4.3.1 The test set up shall be as shown in Fig. 3. Energise the tuner with proper power supply. AGC voltage is set for maximum gain. For a particular channel tune the signal generator to the mid-channel frequency.

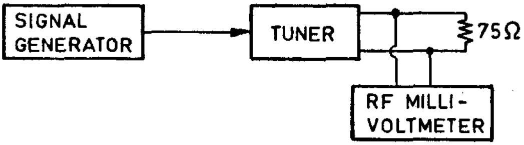


FIG. 3 TEST SET-UP FOR OUTPUT IMPEDENCE MEASUREMENT

4.3.2 Measure the open circuit voltage (E_X) at the output terminal of the tuner.

4.3.3 The tunner output is then terminated by a 75 ohms termination and the voltage at the output is now measured as E_T.

4.3.4 The output impedance R_O is then calculated using the formulae:

$$R_O = \frac{75\ (E_X - E_T)}{E_T}$$

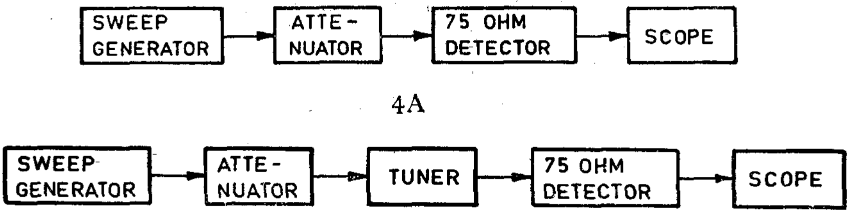
4.3.5 Repeat the measurements for other channels.

NOTE — The measurements done in the above method will result in accuracy of about 10 percent. For more accurate measurements to give the value of impedances in its complex form, that is, resistive and reactive components, more sophisticated equipments, such as vector impedance meters, and Network Analyzers should be used.

4.4 Power Gain

4.4.1 The tuner shall be properly tuned so as to give an IF output of 38·9 MHz. This may be achieved by using the set up shown in **Fig. 1** or any other suitable method.

4.4.2 The test set up shall be as shown in Fig. 4A. Note the reference reading on the scope, for a sweep generator output of 50 dB (mW) and attenuator setting at zero.



4A

4B

FIG. 4 TEST SET-UP FOR POWER GAIN MEASUREMENT

4.4.3 Now set up the equipment as shown in Fig. 4B. Energise the tuner with a proper power supply. AGC voltage is set for maximum gain. Adjust the output of the sweep generator to −50 dB (mW) and set the attenuator to zero.

4.4.4 In case the markers are at the same level, get them to the reference level of **4.4.2** by changing the attenuator setting.

4.4.5 In case the markers are not at the same level, get the mid point of the two markers at reference level of **4.4.2** by changing the attenuator setting.

4.4.6 The variation in the attenuator reading gives the power gain.

4.5 Intermediate Frequency Rejection

4.5.1 The test set up shall be as shown in Fig. 5. Energise the tuner with proper power supply.

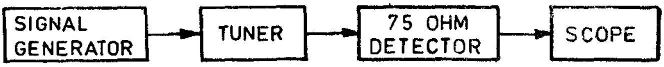


FIG. 5 TEST SET-UP FOR INTERMEDIATE FREQUENCY REJECTION

4.5.2 For a particular channel, feed vision carrier frequency signal of —50 dB (mW). The signal is amplitude modulated by 1 KHz up to 30 percent.

4.5.3 AGC is set for maximum gain and it is ensured that no saturation takes place.

4.5.4 The detected output at 1 KHz is measured.

4.5.5 The frequency of the signal generator is then set to 38·9 MHz and input to the tuner increased, till the same value of detected 1 KHz signal is obtained.

4.5.6 The increase in the input signal level gives the IF rejection in dB.

4.6 Image Rejection

4.6.1 Repeat the measurements as given in **4.5.1** to **4.5.4**.

4.6.2 The frequency of the signal generator is then set to vision carrier frequency ± 2 × Intermediate frequency.

4.6.3 The increase in the input signal level gives image rejection in dB.

4.7 IF Bandwidth

4.7.1 The tuner shall be properly tuned so as to give an IF output of 38·9 MHz. This may be achieved by using the set up shown in Fig. 1 or any other suitable method.

4.7.2 The test set up shall be as shown in Fig. 6. The AGC voltage is set for maximum gain. The signal shall be such that the tuner is not overloaded.

4.7.3 Observe the response on the oscilloscope and measure the 3 dB bandwidth point with respect to the peak.

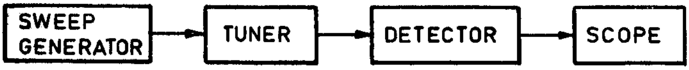


FIG. 6 TEST SET-UP FOR IF BANDWIDTH MEASUREMENT

4.7.4 If a variable frequency signal generator is used, the carrier is amplitude modulated to 30 percent by 1 KHz. The modulated vision carrier frequency signal of −50dB (mW) is fed to the tuner. The detected 1 KHz output is observed.

4.7.4.1 The signal frequency is varied and at each setting the input power is varied so as to give the same value of detected 1 KHz output. The 3 dB bandwidth is there after computed from these data.

4.8 Fine Tuning Range

4.8.1 The tuner shall be properly tuned so as to give IF output of 38·9 MHz. This may be achieved by using the test set up of Fig. 1 or by any other suitable method.

4.8.2 Using the same set up, vary the fine tuning control and read the extreme frequencies to arrive at fine tuning range.

4.9 Noise Figure

4.9.1 *Method A*

4.9.1.1 This measurement shall be carried out in shielded environment to avoid interference from external signal sources.

4.9.1.2 The tuner shall be properly tuned so as to give an IF output of 38·9 MHz. This may be achieved by using the test set up described in **4.1** or any other suitable method.

4.9.1.3 The test set up shall be as shown in Fig. 7A. Energise the tuner with proper power supply.

4.9.1.4 Switch off the noise generator. The noise generator shall cover the entire frequency band under consideration. The input of the tuner is terminated by its own impedence and AGC voltage is set for maximum gain.

4.9.1.5 Measure the noise power output.

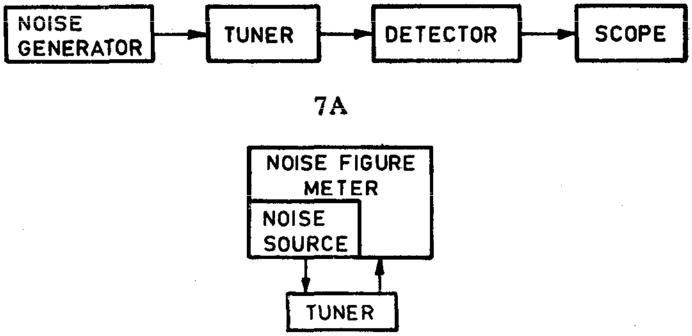
4.9.1.6 The noise generator is switched on and noise input level is gradually increased till the noise power at the tuner output is twice the value noted in **4.9.1.5**.

4.9.1.7 The increase in the noise generator output gives the noise figure.

Note — Some equipments are directly calibrated to give the noise figure from the output calibration of the noise generator. Otherwise, the noise meter which gives a direct reading of the noise figure may be used.

4.9.2 *Method B*

4.9.2.1 The test set up shall be as shown in Fig. 7B.



7A

7B

Fig. 7 Test Set-up for Noise Measurement

4.9.2.2 Read the value of the noise figure directly from the meter in dBs.

4.10 Voltage Standing Wave Ratio

4.10.1 The test set up shall be as shown in Fig. 8. Energise the tuner with proper power supply. AGC voltage is set for maximum gain. Terminate the tuner with its output impedance.

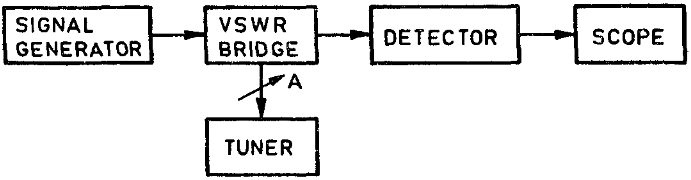


Fig. 8 Test Set-up for Voltage Standing Wave Ratio Measurement

4.10.2 For a particular channel, tune the signal generator to the mid channel frequency.

4.10.3 Set the generator reading at some known attenuation.

4.10.4 Open point A and note reference reading on the scope.

4.10.5 Connect the tuner through point A and reduce attenuation in the scope to get the same reading on the scope.

4.10.6 Calculate the *VSWR* from the formulae:

$$VSWR = \frac{X + 1}{X - 1}$$

where

X is the absolute change of attenuator reading between **4.10.4** and **4.10.5**.

4.11 AGC Range

4.11.1 The test set up shall be as shown in Fig. 9.

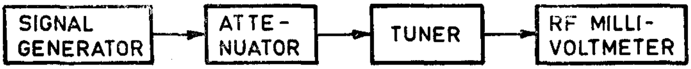


FIG. 9 TEST SET-UP FOR MEASUREMENT OF AGC RANGE

4.11.2 Energise the tuner with proper power supply. AGC voltage is set for maximum gain. For a particular channel feed vision carrier frequency.

4.11.3 The input signal level is kept at —50 dB (mW) level and the output level is noted.

4.11.4 The input signal is increased gradually and the output level is maintained at the same level by adjusting AGC voltage.

4.11.5 The input signal level for which the output cannot be controlled by variation of AGC voltage is noted.

4.11.6 The difference of two readings of input signals is AGC range.

4.12 Local Oscillator Characteristics

4.12.1 *Reset Error*

4.12.1.1 The test set up shall be as shown in Fig. 1.

4.12.1.2 Energise the tuner with proper power supply.

4.12.1.3 For a particular channel, feed the signal and note the readings of the local oscillator frequency by means of a Frequency Counter at the Local Oscillator Test Point (T.P. — L.O.). In case

T.P. — L.O. is not available, the measurements may be carried out at IF output point at IF frequency.

4.12.1.4 Rotate the channel selector by 360 degree and come back to the same channel. Observe the drift in frequency, which gives the reset error.

4.12.2 *Frequency Drift Due to Variation in Power Supply*

4.12.2.1 Repeat measurements from **4.12.1.1** to **4.12.1.3**.

4.12.2.2 Vary the power supply within specified range and observe the frequency drift after a stabilization period of 5 minutes.

4.12.3 *Frequency Drift Due to Change in ambient Temperature*

4.12.3.1 Repeat measurements as given in **4.12.1.1** to **4.12.1.3**.

4.12.3.2 Subject the tuner to the specified temperature in the following sequence and observe the drift in local oscillator frequency or IF:

a) Measure the frequency at ambient temperature.

b) Subject the tuner to lower category temperature and after stabilization period of one hour measure the frequency.

c) The tuner is brought back to ambient temperature and permitted one hour of normalization period.

d) Subject the tuner to upper category temperature and after stabilization of one hour measure the frequency.

4.12.3.3 The difference in readings of **4.12.3.2**(b) and **4.12.3.2**(d) indicates the drift.

4.12.4 *Local Oscillator Radiation*

4.12.4.1 This shall be measured in accordance with IS : 6873 (Part 3)-1977*.

4.13 Automatic Fine Tuning (AFT)

4.13.1 The test set up shall be as shown in Fig. 1.

4.13.2 Energise the tuner with proper supply and feed specified AFT voltage on the AFT terminal.

4.13.3 For a particular channel feed vision carrier frequency and note the local oscillator frequency at the T.P.-L.O. In case the T.P.-L.O. is not available the measurements may be carried out at IF output point at IF frequency.

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*Methods of measurement of electromagnetic interference: Part 3 From sound and television receivers.

4.13.4 Adjust AFT voltage to lower extreme value and adjust input signal frequency to get same reading as in **4.13.3**. Input frequency is noted.

4.13.5 Adjust AFT voltage to higher extreme value and adjust input signal frequency to get reading as in **4.13.3**. Input frequency is noted.

4.13.6 Difference in readings of **4.13.4** and **4.14.5** is AFT range.

4.14 Mechanical Parameters

4.14.1 *Channel Selector Shaft Torque*

4.14.1.1 Mount and tuner on torque meter through a suitable locking arrangement.

4.14.1.2 Apply torque and note down the locked reading on torque meter when the tuner spindle operates to next channel.

4.14.1.3 Repeat the procedure on all the channels of shaft and worst reading is noted as the shaft torque.

4.14.2 *Fine Tuning Shaft Torque*

4.14.2.1 Repeat **4.14.1** after mounting the tuner on suitable jig for fine tuning shaft.

4.14.3 *Detent Mechanism (Pull Back Angle)*

4.14.3.1 Mount the tuner on a suitable jig and apply pressure in one direction up to 4 degree and release the pressure allowing the spind' to come back to normal position.

4.14.3.2 Repeat **4.14.3.1** in reverse direction.

4.14.4 *Channel Selector Shaft Strength*

4.14.4.1 Mount the tuner on a suitable jig and mount the assembly on a tensile strength machine.

4.14.4.2 Apply the desired tensile strength and permit for the desired period.

4.14.5 *Fine Tuning Shaft Strength*

4.14.5.1 Mount the tuner on a suitable jig and repeat **4.14.4**.

4.14.6 *Selector Shaft Rotation*

4.14.6.1 Mount the tuner on a suitable selector shaft rotation jig and adjust the preset for specified number of operations.

4.14.6.2 Allow the tuner to be operated for desired number of operations.

APPENDIX A

(*Clause* 0.3)

RECOMMENDED LIST OF TEST EQUIPMENT REQUIRED WITH TUNER MANUFACTURER FOR TUNER TESTING

Sl No.	*Equipment*
	Mandatory
1.	VHF/UHF Sweep Generator
2.	VHF Signal Generator
3.	UHF Signal Generator
4.	Frequency Counter 1 000 MHz
5.	RF Millivoltmeter
6.	Noise Figure Meter or Noise Generator
7.	R F Attenuator
8.	Oscilloscope 100 MHz
9.	Alignment Scope
10.	RF Detector
11.	LCR Bridge
12.	Torque Meter
13.	Power Supply Units
14.	Isolation Transformer
15.	Set of precision matching networks 50/75, 75/300, 50/300
16.	Precise terminations
	Optional
1.	Polyscope
2.	Digital Multimeter

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